XI.11 Cellulose Production and Increased Biomass in Multifunction Crop Plants (STTR Phase II Project)

Dr. Michael J. Blaylock
Edenspace Systems Corporation
15100 Enterprise Court, Suite 100
Chantilly, VA 20151-1217
Phone: (703) 961-8700; E-mail: blaylock@edenspace.com

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Research Institution
Michigan State University, East Lansing, MI

The production of hydrogen from plant biomass is especially attractive because it is a renewable energy resource and because it recycles atmospheric carbon dioxide. However, new technologies and co-production opportunities are needed to reduce current costs. This project will create new transgenic crop plants characterized by: (1) greater biomass, (2) constitutive production of endoglucanase, hemicellulase, and ligninase (to aid the post-harvest hydrolysis of plant biomass to simple sugars), and (3) delayed flowering as a bioconfinement technique (to increase plant mass and prevent diffusion of transgenes). In Phase I, proof-of-concept was demonstrated in tobacco by combining the Acidothermus cellulolyticus E1 endoglucanase gene with Arabidopsis Flowering Locus C (FLC) gene. The transformed plants demonstrated 10% greater biomass, flowering delays averaging 15 days, excellent cellulose activity, and comparable phytoremediation performance, compared to control plants. In addition, an E1-FLC construct was used to transform maize, which will be grown and tested for bioenergy and phytoremediation applications. Enzyme genes will be added for hemicellulase and a ligninase, in order to increase the percentage of maize biomass that can be converted to biofuels. A pilot demonstration for producing ethanol from transgenic corn stover will be conducted at the National Renewable Energy Laboratory (NREL).